

REMARKS

I. Introduction

Applicants respectfully request reconsideration and allowance.

With entry of the present amendments, claims 1-4 and 6-75 are pending.

Claim 1 is the sole independent claim. Claims 7-38, 41-47, 55, and 57-72 were previously withdrawn and claim 5 was previously cancelled.

Claims 73-75 have been added. No new matter is added by way of amendment. Support for the new claims may be found throughout the application as originally filed, including, but not limited to paragraphs [0050] and [0094]-[0096]. New claims 73-75 read on the elected Species I.

The Applicants respectfully traverse the implication that non-elected, withdrawn claims need to be cancelled at this stage in prosecution. The cited authority provided by the Examiner does not appear to support the Examiner's point. Nevertheless, the Applicants are available to review the matter as needed.

One issue remains: is the sole-independent claim 1 patentable over the cited prior art.

II. Rejections Under 35 U.S.C. § 102(b) – Independent Claim 1 is Novel

Claims 1-3, 6, 39-40, 48, and 54 stand rejected under 35 U.S.C. § 102(b) for allegedly being anticipated by U.S. Pat. No. 5,441,819 by Voss et al. ("Voss"). The Applicants respectfully traverse.

In particular, the Applicants respectfully traverse the rejection of independent claim 1, from which the remaining rejected claims depend. In particular, Voss fails to teach a cathode or anode comprising an "ion conducting material," and therefore fails to teach each and every element of independent claim 1. Although the Office has asserted that the phrase "ion

conducting material” in claim 1 includes Teflon; that Teflon “is capable of at least conducting a few ions”; and that mixing occurs in Voss’ assembly at the interface between the layer of catalytic material and the solid polymer ion exchange membrane, Applicants submit that these assertions—and thus the present rejection—are flawed for at least two reasons. See 9/29/06 Office Action, p. 4 and p. 1.

First, the Office’s construction of the phrase “ion conducting material” is incorrect under the well-established law of claim interpretation.

Second, the Office has not met its burden of proof in establishing a *prima facie* case of anticipation based on Voss.

A. The Office’s construction of the phrase “ion conducting material” is incorrect under the well-established law of claim interpretation.

The Office’s *prima facie* case of anticipation is based, in part, upon an assertion that the phrase “ion conducting material” in claim 1 includes Teflon. Applicants respectfully submit that this assertion is incorrect under the law of claim interpretation.

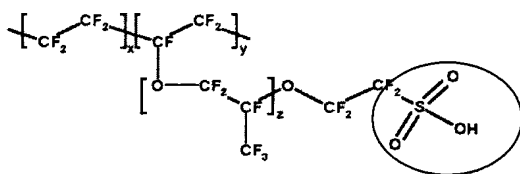
It is well-established that claims are to be given their broadest reasonable interpretation that is both consistent with the specification and with the interpretation that those skilled in the art would reach.

The Patent and Trademark Office (“PTO”) determines the scope of claims in patent applications not solely on the basis of the claim language, but upon giving claims their broadest reasonable construction “in light of the specification as it would be interpreted by one of ordinary skill in the art.” Philips v AWH Corp., 415 F.3d 1303, 1316 (Fed. Cir. 2005) (en banc); MPEP 2111.

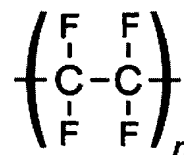
Applicants submit that the Office’s assertion that the phrase “ion conducting material” includes Teflon is not a reasonable interpretation of “ion conducting material” as that phrase is used in the present specification and would be understood by one of ordinary skill in the art.

First, there is no basis in the specification for such an interpretation. Although the specification does not explicitly define an “ion conducting material,” exemplary ion conducting materials are described. See paragraph [0050]. Ion conducting materials at least

include perfluorinated sulfonic acid polymers, such as Nafion. Perfluorinated sulfonic acid polymers comprise charge carriers in the form of ionic groups—sulfonic acid groups (-SO₃H). It is the presence of charge carriers that enables these polymers (and other ion conducting materials) to conduct ions. By contrast, Teflon has no charge carriers, either in the form of ionic groups or otherwise. Consequently, Teflon cannot conduct ions and is a known insulating material. To help further make this point, representative molecular structures of Nafion and Teflon are provided below.



Nafion, charge carrier circled



Teflon, no charge carriers

In view of the exemplary ion conducting materials disclosed in the present specification and the molecular differences between those exemplary ion conducting materials and Teflon, Applicants submit there is simply no basis in the specification for interpreting an ion conducting material to include Teflon.

Second, there is no basis in the prior art for such an interpretation. Not only has the Office failed to provide any evidence that one of skill in the art would reasonably interpret an ion conducting material to include Teflon, but also, there is ample evidence to the contrary. In particular, one of the Office's cited references, Voss, explicitly distinguishes a known ion conducting material, Nafion, from Teflon. Voss states:

Perfluorosulfonic ion exchange membranes, such as those sold by DuPont under its Nafion trade designation, must be hydrated or saturated with water molecules for ion transport to occur. It is generally accepted that such perfluorosulfonic membranes transport cations using a "water pumping" phenomenon. Col. 1, lines 58-63.

Still another conventional water removal technique is to incorporate hydrophobic substances, such-as polytetrafluoroethylene (trade name Teflon) into the cathode sheet material to urge accumulated water away from the cathode. Col. 2, lines 31-35.

The carbon fiber paper sheets 18 are usually impregnated with a hydrophobic polymer, such as TEFLON brand polytetrafluoroethylene, to render the carbon fiber paper sheets 18 hydrophobic. Col. 7, lines 49-52.

Thus, Voss recognizes Nafion and Teflon to be different materials with different properties. These properties include the materials' hydrophobicity (or hydrophilicity), which is related to the materials' ability to conduct ions. Nafion is hydrophilic (due to those ionic groups described above) and is able to conduct ions. Teflon is hydrophobic (due to the lack of any ionic groups) and cannot conduct ions.

Applicants further direct the Office's attention to the reference provided in the attached Appendix, "Nafion: Physical and Chemical Properties," which summarizes the development and properties of Nafion. Slide 14 of the reference explicitly distinguishes Nafion from Teflon by stating that "unlike Teflon, Nafion is highly ion-conductive." Both Voss and Nafion reference establish that those of ordinary skill in the art are well aware that Nafion and Teflon belong to distinct classes of materials—ion conducting materials and insulating materials, respectively. Thus, Applicants submit that those of ordinary skill in the art would not "misinterpret" or "misconstrue" the phrase "ion conducting material" to include Teflon. 9/29/06 Office Action, p. 14.

In summary, the Office's interpretation of "ion conducting material" as including Teflon is incorrect because it is both inconsistent with the specification and the interpretation that those of ordinary skill in the art would reach. Thus, Voss' disclosure of an assembly having a Teflon-impregnated electrode fails to anticipate the present claims. Accordingly, Applicants respectfully request that the present rejection of claim 1, and any claims depending therefrom, be withdrawn.

B. The Office has not met its burden of proof in establishing a *prima facie* case of anticipation based on Voss.

The Office's *prima facie* case of anticipation is based upon two additional assertions. First, the Office asserts that Teflon is "capable of at least conducting few ions." Specifically, the Office states:

While the examiner does not dispute that TEFLON does exhibit a low degree of conductivity, the examiner strenuously avers that Teflon per se is capable of at least conducting few ions...In other words, even though TEFLON material may lack a micro-structural arrangement providing a suitable mechanism for high degree of ion conductivity, such as to promote conduction; applicant has not demonstrate that TEFLON itself is 100% incapable of being an ion conductor...If applicant can show or demonstrate that TEFLON cannot, by any

means, conduct ions or is incapable of conducting ions at all (emphasis supplied) by presenting objective or sound evidence, then all applicable grounds of rejection on this matter will be removed. 9/29/06 Office Action, p. 13.

Second, the Office asserts that mixing occurs in Voss' assembly at the interface between the layer of catalytic material and the solid polymer ion exchange membrane. Specifically, the Office states:

Voss et al disclose that is known to use a perfluorosulfonic ion exchange membrane such as Nafion as the electrolyte membrane (COL 7, lines 24-28). *Furthermore, given that the layer of catalytic material is in direct contact with the electrolyte membrane, it is contended that mixing of catalytic material and electrolyte membrane occurs at the interface formed therebetween. Thus, the catalytic material contains such electrolyte membrane at least at the interface.* 9/29/06 Office Action, p. 4.

Thus, the Office's *prima facie* case is based upon a theory of inherency—that Teflon necessarily possesses the ability to conduct at least a few ions and that mixing necessarily occurs at the interface in Voss' assembly.

It is well-established that the Office bears the initial burden of proof in establishing a *prima facie* case of anticipation based upon a theory of inherency.

In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) and MPEP 2112.

Moreover,

To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.' *In re Robertson*, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999).

Applicants respectfully submit that the Office has not met its burden of proof in establishing that Teflon necessarily possesses the ability to conduct at least a few ions or that mixing necessarily occurs at the interface in Voss' assembly.

Regarding the first assertion, even it were logically or physically possible to prove the negative that Teflon is "100% incapable of being an ion conductor," Applicants submit that

the Office's request is misplaced in view of its high evidentiary burden set forth in *Ex parte Levy*, *In re Robertson* and MPEP 2112. Accordingly, Applicants request that the Office provide a basis in fact and/or technical reasoning that Teflon necessarily possesses the ability to conduct ions (i.e., something more than the Office's mere contention that the alleged fact is true). Given that Teflon does not possess any charge carriers and that those of ordinary skill in the art characterize Teflon as a material that is incapable of conducting ions (i.e., an insulating material), Applicants submit that the Office will not be able to provide the requisite evidence. Nevertheless, as thoroughly discussed above, even if such evidence exists, neither the specification, nor the prior art supports interpreting the phrase "ion conducting material" to include Teflon.

Regarding the second assertion, Applicants request that the Office provide a basis in fact and/or technical reasoning that such mixing necessarily occurs at the interface in Voss' assembly. Certainly nothing in Voss suggests that any mixing occurs at all. Moreover, the Office has provided no reasonable basis (either in the specification or in the prior art) for construing a "mixture" of two components (as recited in claim 1) to encompass adjacent layers of two components (as taught by Voss). For example, brass is a mixture of zinc and copper. No one skilled in the art would argue that brass is a layer of zinc in contact with a layer of copper.

In summary, because the Office has failed to support the assumptions underlying the present rejection with a basis in fact and/or technical reasoning, the *prima facie* case of anticipation based on Voss must fail. For this additional reason, Applicants respectfully request that the present rejection of claim 1, and any claims depending therefrom, be withdrawn.

II. Rejections Under 35 U.S.C. § 103(a) – Independent claim 1 is non-obvious

A. Claims 1-3, 4, 6, 39-40, and 48-54

Claims 1-3, 4, 6, 39-40, 48-54 stand rejected under 35 U.S.C. § 103(a) for allegedly being unpatentable over Voss in view of U.S. Pat. No. 5,242,764 by Dhar ("Dhar"). The Applicants respectfully traverse.

In particular, the Applicants respectfully traverse the rejection of independent claim 1, from which the remaining rejected claims depend for at least three reasons.

First, even if the teachings of Voss and Dhar were combined, the combination would not provide a membrane electrode assembly that indicates each and every element of independent claim 1.

Second, not only does the Office's reason for combining the references fail to support the *prima facie* case of obviousness, but also Dhar explicitly teaches away from a membrane electrode assembly which includes both a separator comprising an ion conducting material and a catalytic material comprising a mixture of a catalyst component and an ion conducting material.

Finally, those of ordinary skill in the art would not find it obvious to modify Voss to include the teachings of Dhar since such a modification would change the principle of operation of Voss' assembly.

1. Even if the teachings of Voss and Dhar were combined, the combination would not include each and every element of independent claim 1.

Even assuming *arguendo*, one did combine the teachings of Voss and Dhar, the combination would not provide a membrane electrode assembly including each and every element recited in independent claim 1. Claim 1 recites a cathode and an anode each having a catalytic material on the electrode surface, the catalytic material "comprising a catalytically effective amount of a mixture of at least one catalyst component and at least one ion conducting material." An embodiment of claim 1 is described in the example of paragraphs [0094]-[0096]. In this example, a catalytic material was prepared by mixing a catalyst component (platinum) with a solution of an ion conducting material (Nafion). Paragraphs [0094]-[0095]. The resulting mixture was then painted onto the surfaces of the anode and cathode. Paragraph [0096].

By contrast, Dhar teaches that the disclosed electrodes are coated with separate layers of a catalyst and a proton conducting material. Dhar, FIG. 1 and col. 5, lines 23-38. Nowhere does Dhar teach or suggest that the electrodes be coated with a mixture of a catalyst

component and an ion conducting material. As discussed above, neither the specification, nor evidence in the prior art supports interpreting a mixture of two components as adjacent layers of two components.

Because the combination of Voss and Dhar fail to teach or suggest each and every element of independent claim 1, the combination fails to render the claim obvious. Accordingly, Applicants respectfully request that the present rejection of claim 1, and any claims depending therefrom, be withdrawn.

2. Not only does the Office's reason for combining Voss and Dhar fail to support the *prima facie* case of obviousness, but also, Dhar explicitly teaches away from the claimed membrane electrode assembly.

Applicants respectfully submit that the Office's *prima facie* case of obviousness is flawed on additional grounds. Not only does the Office's reason for combining Voss and Dhar fail to support the *prima facie* case of obviousness, but also, Dhar explicitly teaches away from the claimed membrane electrode assembly.

As noted above, the Office asserts that one of ordinary skill in the art would have had a reason to modify Voss to include the teachings of Dhar in order to "further separate the anode side of the fuel cell from the cathode side thereof, thereby avoiding detrimental or catastrophic damages to the fuel cell." 9/29/06 Office Action, p. 9. This reason appears to be derived from the general principle that a barrier is needed in fuel cell assemblies to prevent the mixing of the reactant gases (hydrogen and oxygen). However, as Voss repeatedly emphasizes, the disclosed membrane electrode assembly includes a solid polymer ion exchange membrane in order to "isolate the hydrogen-containing gas supply from the oxygen-containing gas supply." See, e.g., col. 1, lines 50-53 and col. 7, lines 16-23. In other words, Voss' assembly already avoids any "detrimental or catastrophic damages" to its fuel cell by including the disclosed solid polymer ion exchange membrane in the assembly. Thus, the reason the Office has provided for modifying Voss to include the teachings of Dhar is redundant, and thus, fails to support the *prima facie* case of obviousness.

Moreover, even if the skilled artisan were to consider modifying Voss to incorporate Dhar's teachings, Applicants submit that this person would surely consider Dhar in its

entirety, as the Office must do under MPEP 2141.02 VI. (“A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention.” *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 USPQ 303 (Fed. Cir. 1983)). Considering Dhar in its entirety, the reference does not simply teach including separate layers of a catalyst and a proton conducting material on the disclosed electrodes, but also teaches that under such conditions, the use of an electrolyte membrane to further separate the coated electrodes is not only unnecessary, but should be avoided. Specifically, Dhar emphasizes:

With sufficient deposits [of proton conducting material] on both electrodes, it is then possible to avoid the use of electrolyte membrane which is used in the state-of-the-art solid polymer fuel cell design. Abstract.

Referring to FIG. 1, Dhar warns:

The purpose of the hole (32) in the membrane is to avoid an additional electrolyte on top of the deposited layer [of proton conducting material] and hence to avoid an unnecessary increase in the electrolyte resistance. Col. 5, lines 45-49, emphasis added.

Finally, Dhar explains why an increase in the electrolyte resistance that would accompany the inclusion of additional electrolyte on top of the deposited layer of proton conducting material should be avoided:

A small amount of electrolyte deposit on an electrode allows for operation under much reduced ohmic resistance. A reduced ohmic resistance compensates for the kinetic advantage that is obtainable for the above two halfcell reactions at a higher temperature and pressure. Thus, the fuel cell operation becomes feasible at a lower temperature and pressure. The above conditions allow the electrolyte to retain sufficient water that is formed by the electrochemical reaction during fuel cell operation allowing a continuous cell performance without membrane failure. Col. 3, lines 34-45.

In other words, Dhar teaches that when a layer of a proton conducting material is deposited on the electrodes, no additional proton conducting material in the form of an electrolyte membrane should be included on top of the deposited layer because that would undesirably increase the electrolyte resistance and lead to membrane failure. Instead, the electrolyte membrane should be eliminated altogether between the coated electrodes by including a central hole in the membrane. Thus, Dhar explicitly teaches away from the claimed membrane electrode assembly, which includes both a separator comprising an ion conducting

material and a catalytic material comprising a mixture of a catalyst component and an ion conducting material. In view of this teaching away, even if one of ordinary skill in the art were to combine the teachings of Voss and Dhar, the combination would not result in the assembly recited in present claim 1.

Because the Office has failed to identify an applicable reason for combining the teachings of Voss and Dhar, and because Dhar teaches away from the claimed membrane electrode assembly, the *prima facie* case of obviousness must fail. For this additional reason, Applicants respectfully request that the present rejection of claim 1, and any claims depending therefrom, be withdrawn.

3. Those of ordinary skill in the art would not consider it obvious to modify Voss as asserted since such a modification would change the principle of operation of Voss' assembly.

Finally, Applicants respectfully submit that the person of ordinary skill in the art would not consider it obvious to modify Voss to incorporate the teachings of Dhar since such a modification would change the principle of operation of Voss' assembly. ("If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 123 USPQ 349 (CCPA 1959) and MPEP 2143.01 VI.) Voss' assembly is directed to addressing certain problems associated with polymer electrolyte membrane containing fuel cells. In particular, Voss' assembly addresses both the problems of accumulating water at the cathode and the need to keep the polymer electrolyte membrane adequately hydrated for optimal performance. Col. 1, line 58 – col. 2, line 21. The fundamental principle of operation of Voss' assembly involves controlling the partial pressure of water vapor in the hydrogen and/or oxygen gas supplies to facilitate drawing water across the polymer electrolyte membrane by a concentration gradient. Abstract. Modification of Voss' assembly to include the teachings of Dhar (in its entirety) would require eliminating the polymer electrolyte membrane and replacing it with layers of electrolyte on the anode and cathode. Eliminating the polymer electrolyte membrane effectively nullifies the principle of operation of Voss' assembly, which is based on controlling water flow across the membrane. Because the person of ordinary skill in the art

would have no reason to adopt a modification that would change the fundamental principle of the prior art device being modified, the asserted modification of Voss cannot be considered obvious. For this additional reason, Applicants respectfully request that the present rejection of claim 1, and any claims depending therefrom, be withdrawn.

B. Claim 56

Claim 56 stands rejected under 35 U.S.C. § 103(a) for allegedly being unpatentable over Voss alone or in view of Dhar and in further view of U.S. Pat. Pub. No. 2004/0241531 by Biegert et al. (“Biegert”). Applicants respectfully traverse.

Claim 56 depends from claim 1. As thoroughly discussed in Sections I and II.A., neither Voss, nor the combination of Voss and Dhar, teaches or renders obvious the membrane electrode assembly recited in claim 1. Nothing in Biegert cures these deficiencies. Accordingly, Applicants respectfully request that the present rejection of claim 56 be withdrawn.

III. New Claims

New dependent claims 73-75 depend from claim 1 which are also patentable.

With further regard to claims 73 and 74, each of these claims more precisely defines the phrase “ion conducting material” as a material which comprises charge carriers (claim 73) or as a material which comprises ionic groups (claim 74). As discussed above, Teflon neither comprises charge carriers nor ionic groups. Accordingly, the membrane electrode assembly of claims 73 and 74 is clearly distinguished from the membrane electrode assembly of Voss. For this additional reason, Applicants submit that claims 73 and 74 are patentable.

Regarding claim 75, this claim more precisely defines the membrane electrode assembly by reciting that “the cathode, the anode, or both comprise a layer of the catalytic material on at least a portion of the first surface thereof and the at least one ion conducting material is dispersed throughout the layer of the catalytic material.” Neither Voss nor Dhar teaches or suggests a membrane electrode assembly having a layer of catalytic material on the surface of the cathode, the anode, or both, wherein an ion conducting material is dispersed

throughout the layer of catalytic material. For this additional reason, Applicants submit that claim 75 is patentable.

CONCLUSION

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. Should any issues remain open after consideration of the present amendment and reply, the Examiner is invited to contact the undersigned so that a prompt disposition of the application may be achieved.

The Commissioner is hereby authorized to charge any fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check or credit card payment form being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any additional extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for such extension under 37 C.F.R. §1.136 and authorize payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date: June 4, 2009

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